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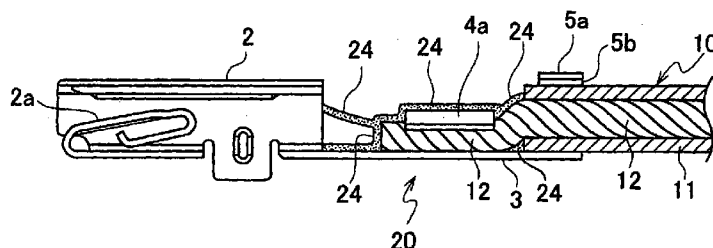
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(54) Title: CONNECTION STRUCTURE OF CRIMPING CONNECTION PART OF ALUMINUM ELECTRIC WIRE AND METAL TERMINAL AND METHOD FOR MANUFACTURING THE SAME

FIG.1



(57) Abstract: In a structure of a crimping connection part of an aluminum electric wire and a metal terminal, the aluminum electric wire includes a core wire and an insulating sheath covering the core wire, an exposed core wire in which the core wire is exposed from the insulating sheath at an end portion of the aluminum electric wire is crimped by a core wire crimping part of the metal terminal to form the crimping connection part, and the exposed core wire and the metal terminal of the crimping connection part are covered by a vapor deposited film comprised of an electrically conductive powder.

DESCRIPTION

CONNECTION STRUCTURE OF CRIMPING CONNECTION PART OF
ALUMINUM ELECTRIC WIRE AND METAL TERMINAL AND METHOD FOR
5 MANUFACTURING THE SAME

Technical Field

The present invention relates to a structure of a crimping connection
part of an aluminum electric wire and a metal terminal, and a method for
10 manufacturing the same, specifically to a corrosion prevention technology of a
crimping connection part.

Background Art

For the purpose of achieving weight reduction of vehicles such as
15 automobiles, attention is paid to the use of an aluminum or aluminum alloy
electric wire (hereinafter generically named "aluminum electric wire"). The
aluminum electric wire is formed by applying insulating sheath to a single wire
core wire or a core wire obtained by twisting a plurality of aluminum wires. In
the case of wirings of vehicles such as automobiles, a wire harness prepared by
20 bundling a plurality of electric wires formed by crimp-connecting a metal
terminal on both ends of an aluminum electric wire and arranging the shape in
conformity with a wiring route is used.

For the metal terminal, in general, a copper or copper alloy terminal
25 (hereinafter generically named "copper terminal") is used, and the aluminum

electric wire is crimped by the copper terminal to obtain electrically connection.

In that case, an open type wire barrel folded in a U-shape (core wire crimping part) is formed in a part of the copper terminal, the core wire formed by peeling off the insulating sheath of the end portion of the aluminum electric wire is

located within the wire barrel, and the wire barrel is caulked to achieve crimping connection. In addition, an insulation barrel (insulating sheath crimping part)

folded in a U-shape is formed on the end portion of the copper terminal, an insulating sheath of the end portion of the aluminum electric wire is located within the insulation barrel, and the insulation barrel is then caulked, thereby

firmly crimping and holding the copper terminal on the aluminum electric wire (see, for example, PTLs (Patent Literatures) 1 to 3).

When moisture in the air is condensed and penetrates, or rainwater or the like penetrates into the crimping connection part between the aluminum electric wire and the copper terminal as thus crimp-connected, there is caused a problem of galvanic corrosion in which an ion of aluminum which is more easily oxidized elutes in correspondence to a difference of oxidation-reduction potential (ionization tendency) between the aluminum electric wire and the copper terminal as different metals from each other, thereby causing corrosion.

Incidentally, in the case where a tin (Sn) plating is applied on the surface of the copper terminal, corrosion is similarly caused on the side of the aluminum electric wire due to a difference of oxidation-reduction potential between aluminum and tin. When the aluminum electric wire corrodes, there is caused such inconvenience that electrical characteristics of the connection part become instable due to an increase of contact resistance of the connection part, an

increase of electrical resistance by a reduction of wire diameter, or the like.

Then, PTL 1 proposes that a resin is coated on the entirety of the crimping connection part of the aluminum electric wire and the copper terminal, thereby preventing the penetration of water into the contact part of the aluminum electric wire and the copper terminal from occurring. In addition, PTL 2 proposes that the crimping connection part of the aluminum electric wire and the copper terminal is covered by a metal housing body having a larger ionization tendency, namely a higher oxidation-reduction potential than that of aluminum and copper, and the metal housing body is sacrificially corroded, thereby suppressing the corrosion of aluminum. Furthermore, PTL 3 proposes that a resin such as a silicone rubber is coated on an exposed core wire part from which the insulating sheath of the aluminum electric wire has been peeled off, to apply a waterproofing coating, the copper terminal is then crimped by a strong force to break the waterproofing coating, thereby bringing the aluminum electric wire and the copper terminal into contact with each other. According to this, the penetration of water into the contact part of the aluminum electric wire and the copper terminal is suppressed, whereby the corrosion of the aluminum core wire can be prevented from occurring.

Citation List

Patent Literature

[PTL 1] JP-A-2010-108798

[PTL 2] JP-A-2010-238393

[PTL 3] JP-A-2010-55901

Summary of Invention

Technical Problem

Now, in the case of coating a resin on the entirety of the crimping
5 connection part of the aluminum electric wire and the copper terminal as
described in PTL 1, after coating a flowable resin, light such as ultraviolet rays
is irradiated to cure the resin. But, in view of the fact that the control of a
coating amount or a thickness of the resin is difficult, there is involved such a
problem that the inspection for all products must be carried out. In order to
10 solve such a problem, it may be considered to integrally mold a resin coating
surrounding the entirety of the crimping connection part of the aluminum electric
wire and the copper terminal using a die; however, it is not practically useful to
prepare a die for every electric wire size basis.

15 In addition, according to a method for covering by a metal housing body
to be sacrificially corroded in the crimping connection part of the aluminum
electric wire and the copper terminal as proposed in PTL 2, since the size of the
connection part becomes large, when the metal terminals having the connection
parts are formed into a wire harness, a pitch between the adjacent metal
20 terminals must be widened. For that reason, there is involved such a problem
that a connector housing for housing a plurality of metal terminals side by side
becomes large in size.

On the other hand, in the case of PTL 3, since the resin such as a
25 silicone rubber is an insulating material, there is a concern that even when the

aluminum electric wire coated with the silicon rubber crimped by the copper terminal with a strong force, the coating made of the silicone rubber is not sufficiently broken, and a problem remains on the reliability of electrical contact between the aluminum electric wire and the copper terminal. In addition, the size of the connection part becomes large in accordance with a thickness of the silicone rubber coating. For that reason, since in a connector housing for housing a plurality of metal terminals side by side, a pitch between the adjacent metal terminals must be widened, there is involved such a problem that the size becomes large.

A problem to be solved by the present disclosure is to establish a corrosion prevention technology in which the manufacture control of an anticorrosive coating portion is easy, and the reliability of electrical contact between the aluminum electric wire and the metal terminal is not impaired without increasing the size of the crimping connection part.

Solution to Problem

In order to achieve the above object, according to the present disclosure, there is provided a structure of a crimping connection part of an aluminum electric wire and a metal terminal. The aluminum electric wire includes a core wire and an insulating sheath covering the core wire. An exposed core wire in which the core wire is exposed from the insulating sheath at an end portion of the aluminum electric wire is crimped by a core wire crimping part of the metal terminal to form the crimping connection part. The exposed core wire and the metal terminal of the crimping connection part are

covered by a vapor deposited film comprised of an electrically conductive powder.

For example, an electrically conductive material of the electrically
5 conductive powder is one of a metal material having an oxidation-reduction potential with a small difference from an oxidation-reduction potential of a metal material of the metal terminal, carbon, and gold.

For example, the metal terminal is a terminal formed of copper or a
10 copper alloy, and a surface of the terminal is plated with tin, and an electrically conductive material of the electrically conductive powder is one of a metal material having an oxidation-reduction potential with a small difference from an oxidation-reduction potential of tin, carbon, and gold.

15 According to the present disclosure, there is also provided a method for manufacturing the above structure of the crimping connection part, the method comprising:

placing the crimping connection part, in which the exposed core wire of the aluminum electric wire is crimped by the metal terminal, within a vacuum
20 vessel;

generating a vapor within the vacuum vessel by heating an electrically conductive material; and

forming a vapor deposited film on the crimping connection part by condensing the vapor of the electrically conductive material.

25

Advantageous Effects of Invention

According to the present disclosure, a corrosion prevention technology in which the manufacture control of an anticorrosive coating portion is easy, and the reliability of electrical contact between the aluminum electric wire and the metal terminal is not impaired without increasing the size of the crimping connection part can be established.

Brief Description of Drawings

Fig 1 is a cross-sectional view showing a structure of a crimping connection part of an aluminum electric wire and a metal terminal according to an embodiment of the present disclosure.

Fig 2 is a perspective appearance view showing a configuration of a crimping connection part of an aluminum electric wire and a metal terminal according to an embodiment of the present disclosure.

Fig 3 is a schematic view showing a manufacture method of a crimping connection part of an aluminum electric wire and a metal terminal according to an embodiment of the present disclosure.

Description of Embodiments

A structure of a crimping connection part of an aluminum electric wire and a metal terminal of the present disclosure and a manufacture method thereof are hereunder described on the basis of embodiments.

A perspective appearance view of an example of a structure of a crimping connection part of an aluminum electric wire and a metal terminal is

shown in Fig 2. A copper terminal 1 as a metal terminal is formed by
subjecting a plate material made of copper or a copper alloy to press
processing. As shown in Fig 2, the copper terminal 1 is formed so as to
include a male-type or female-type housing terminal part 2, a coupling part 3
5 formed by extending a bottom plate and side plates of the tubular terminal part
2, and a wire barrel 4 as a core wire crimping part and an insulation barrel 5 as
an insulating sheath crimping part, each of which is formed in the coupling part
3. The terminal part 2 is formed as a male-type or female-type terminal by
folding a plate material in a housing form. The wire barrel 4 is formed so as to
10 protrude a pair of barrel pieces 4a and 4b from both side edges of the plate
material of the coupling part 3, and before caulking, the wire barrel 4 is formed
as an open barrel having a U-shaped cross section. Similarly, the insulation
barrel 5 is formed so as to protrude a pair of barrel pieces 5a and 5b from both
side edges of the plate material of the coupling part 3, and before caulking, the
15 insulation barrel 5 is formed as an open barrel having a U-shaped cross section.
In parts of the coupling part 3 which are located between the terminal part 2 and
the wire barrel 4 and between the wire barrel 4 and the insulation barrel 5, side
walls are formed by folding the both side edges of the plate material. The
copper terminal 1 is plated with tin (Sn).

20 In order to crimp-connect the copper terminal 1 to an aluminum electric
wire 10, an insulating sheath 11 of an end of the aluminum electric wire 10 is
first peeled off to expose a core wire 12. The exposed part of the core wire 12
is located at the wire barrel 4, and the both of the exposed part of the core wire
25 12 and the wire barrel 4 are caulked and the exposed part of the core wire 12 is

crimped by the wire barrel 4 such that tips of the barrel pieces 4a and 4b are faced each other. In addition, the insulating sheath 11 of the end of the aluminum electric wire 10 is located at the insulation barrel 5, and the barrel pieces 5a and 5b are superimposed on and wound around the peripheral surface of the insulating sheath 11, followed by caulking. According to this, the aluminum electric wire 10 can be crimped by the copper terminal 1 and also firmly fixed thereto.

A manufacture method by cladding a vapor deposited film made of an electrically conductive powder on a crimping connection part 20 of the copper terminal 1 and the aluminum electric wire 10 as the crimp-connected part a vacuum vapor deposition is described by reference to Fig 3. In Fig 3, while illustration is omitted, the crimping connection part 20 of the copper terminal 1 and the aluminum electric wire 10 is held on a sample table provided within a vacuum vessel. Subsequently, the inside of the vacuum vessel is regulated to a prescribed vacuum pressure (for example, from 10^{-3} to 10^{-5} Pa), a current is flowed through an evaporation source 21 formed in, for example, a dish shape, to cause ohmic heating, and nickel 22 as one of electrically conductive materials housed in the evaporation source 21 is heat melted to produce a nickel vapor. The nickel vapor is condensed within the vacuum vessel to form a metal powder, and a flow 23 of the nickel vapor toward the crimping connection part 20 of the copper terminal 1 and the aluminum electric wire 10 is formed and comes into collision with and attaches onto the surface of the crimping connection part 20, thereby forming a vapor deposited film on the crimping connection part 20. A temperature in the vicinity of the crimping

connection part 20 is adjusted to, for example, from about 60 to 100 °C by separating the crimping connection part 20 from the evaporation source 21 such that the insulating sheath 11 of the aluminum electric wire 10 is not damaged.

5 A thickness of the vapor deposited film can be controlled by adjusting a vapor deposition condition such as a vapor deposition time and a concentration of the nickel vapor. In addition, the flow 23 of an atom or molecule of the nickel vapor can be controlled by opening or closing a partition provided between the crimping connection part 20 and the evaporation source 21.

10 Furthermore, a vapor deposited film is not formed on an unnecessary portion of the crimping connection part 20 by covering the unnecessary portion with a shielding body or a shielding film. In addition, it is shown that the evaporation source 21 is arranged in an upper part of the vacuum vessel and the crimping connection part 20 which is subjective to the formation of the vapor deposited
15 film is arranged in a lower part of the vacuum vessel as shown in FIG 3. However, the top and bottom relation of the evaporation source 21 and the crimping connection part 20 in the location may be reversed.

A structure of the crimping connection part 20 of the aluminum electric
20 wire 10 and the copper terminal 1 according to an embodiment of the present disclosure, in which a vapor deposited film made of a nickel powder is thus formed, is shown in Fig 1. Fig 1 is a cross-sectional view showing the structure of the crimping connection part 20 which is cut by a vertical plane including a major axis of the aluminum electric wire 10 and the copper terminal
25 1. In this embodiment, the crimping connection part 20 in a state that the

aluminum electric wire 10 is crimped by the copper terminal is subjected to vacuum vapor deposition to form the vapor deposited film of nickel on the crimping connection part 20. That is, as shown in Fig 1, the exposed part of the core wire 12 of the aluminum electric wire 10 is crimp-connected with the coupling part 3 by caulking the barrel pieces 4a and 4b of the wire barrel 4 of the copper terminal 1. In addition, the end of the insulating sheath 11 of the aluminum electric wire 10 is fixed to the coupling part 3 by caulking the barrel pieces 5a and 5b of the insulation barrel 2. Incidentally, in this embodiment, while a female-type terminal provided with a curved elastic deformable contact 2a is used as the terminal part 2, the present disclosure is not limited thereto but it is similarly applicable to a male-type terminal as the terminal part 2.

Next, a characteristic configuration of the present disclosure is described by reference to Fig 1. As a result of subjecting the crimping connection part 20 to vapor deposition of nickel by using the vacuum vapor deposition as explained in Fig 3, a vapor deposited film 24 made of a nickel powder is formed on an outer surface of the copper terminal 1 and an outer surface of the exposed core wire 11 of the aluminum electric wire 10 which constitute the crimping connection part 20. Though a thickness of the vapor deposited film 24 to be actually formed can be made extremely thin, the thickness of the vapor deposited film 24 is shown in an exaggerated way in Fig 1. As illustrated in Fig 1, the vapor deposited film 24 covers the peripheral surface and cut surface of the exposed core wire 11 and also covers the outer surfaces and end surfaces of the barrel pieces 4a and 4b, and furthermore, the vapor deposited film 24 is vapor deposited on the outer surface of the coupling

part 3. Incidentally, the vapor deposited film may be formed on the outer surface and end surface of the insulation barrel 5, the outer surface of the insulation coating 11 in the vicinity of the insulation barrel 5, and the outer surface of the terminal part 2, and the like. This embodiment is concerned with
5 an example in which the above portions are covered by a shielding body so as to avoid forming a vapor deposited film thereon.

As described above, according to this embodiment, since the crimping connection part 20 of the copper terminal 1 and the aluminum electric wire 10 is
10 covered by the vapor deposited film 24 made of the nickel powder, a fine gap of the crimping connection part 20 between the peripheral surface and cut surface of the core wire 12 of the aluminum electric wire 10 and the copper terminal 1 can be filled with the vapor deposited film made of the nickel powder. As a result, the penetration of water into the crimping connection part 20 is
15 suppressed, whereby the corrosion of the aluminum core wire can be prevented from occurring. In addition, since the surface of the exposed part of the core wire 12 of the aluminum electric wire 10 is covered by the vapor deposited film made of the nickel powder, the contact part or boundary part between aluminum and the tin plating of the copper terminal is not exposed. As a result, even
20 when water is present in the crimping connection part 20 and surroundings thereof, electric corrosion of aluminum is hardly caused.

In addition, since the vapor deposited film 24 is formed as an anticorrosive coating film by vacuum vapor deposition, by adjusting a vacuum
25 vapor deposition condition (for example, a vapor concentration or a vapor

deposition time of the electrically conductive material), a thickness of the vapor deposited film can be freely controlled, for example, in the order of μm unit. As a result, the manufacture control of an anticorrosive coating film is easy, and the anticorrosive coating film can be formed without increasing the size of the crimping connection part 20. For that reason, the corrosion prevention of the aluminum electric wire can be realized without increasing the size of a terminal housing chamber of a connector housing for housing a plurality of copper terminals side by side. Furthermore, since the vapor deposited film 24 is made of a nickel powder, the reliability of electrical contact between the aluminum electric wire 10 and the copper terminal 1 is not impaired.

In the above embodiment, the vapor deposited film 24 is formed of nickel, however, it should not be construed that the present disclosure is limited thereto, and the vapor deposited film 24 can be formed by using carbon or the like, in addition to a metal such as tin and gold. In addition, not only the copper terminal but also other metal terminals can be applied. In the case of a vapor deposited film made of a metal powder, a metal material having a small oxidation-reduction potential difference from the metal of the metal terminal is chosen. According to this, even when water is present in an exposed part at the boundary between the vapor deposited film made of a metal powder and the metal terminal, the occurrence of electric corrosion can be prevented.

In addition, in the foregoing embodiment, while an example of a copper terminal made of copper or a copper alloy, the surface of which is plated with tin, has been described, the present disclosure can also be applied to a copper

terminal not plated with tin.

Here, the detail of the above embodiment is summarized as follows.

In a structure of a crimping connection part of an aluminum electric
5 wire and a metal terminal, the aluminum electric wire includes a core wire and
an insulating sheath covering the core wire, an exposed core wire in which the
core wire is exposed from the insulating sheath at an end portion of the
aluminum electric wire is crimped by a core wire crimping part of the metal
terminal to form the crimping connection part, and the exposed core wire and
10 the metal terminal of the crimping connection part are covered by a vapor
deposited film comprised of an electrically conductive powder.

For example, the vapor deposited film comprised of the electrically
conductive powder can be formed using a metal such as nickel, tin, and gold
15 and besides, carbon or the like. Such a vapor deposited film can be formed by
means of well-known vacuum vapor deposition, and by adjusting a vacuum
vapor deposition condition (for example, a vapor concentration or a vapor
deposition time of the electrically conductive material), a thickness of the vapor
deposited film can be freely controlled, for example, in the order of μm unit. In
20 addition, since a fine gap in the crimping connection part between the peripheral
surface of the core wire of the aluminum electric wire and the metal terminal can
be filled with the electrically conductive powder, the corrosion of the aluminum
core wire of the crimping connection part can be prevented from occurring by
suppressing the penetration of water. Incidentally, since the surface of the
25 exposed core wire of the aluminum electric wire is covered by the vapor

deposited film comprised of the electrically conductive powder, a contact part or boundary part of the different metals from each other is not exposed, so that even when water is present in the crimping connection part and surroundings thereof, electric corrosion is hardly caused. As a result, since the manufacture control of an anticorrosive coating film is easy, and also, the anticorrosive coating film can be formed thin, the anticorrosive coating film can be formed without increasing the size of the crimping connection part. In addition, since the vapor deposited film has electrical conductivity, the reliability of electrical contact between the aluminum electric wire and the metal terminal is not impaired.

In the present disclosure, for example, the electrically conductive powder for forming the vapor deposited film is an electrically conductive material selected among a metal material having an oxidation-reduction potential with a small difference from an oxidation-reduction potential of the metal material of the metal terminal, carbon, and gold. According to this, even when water is present in an exposed part at the boundary between the vapor deposited film made of a metal powder and the metal terminal, the occurrence of electric corrosion can be prevented.

Here, needless to say, the present disclosure can be applied to a metal terminal made of copper or a copper alloy. In addition, in the case where the present disclosure is applied to a metal terminal made of copper or a copper alloy, the surface of which has been plated with tin, the electrically conductive powder constituting the metal vapor deposited film can be made an electrically

conductive material selected among a metal material having an oxidation-reduction potential with small difference from an oxidation-reduction potential of tin (for example, tin or nickel), carbon, and gold.

5 The vapor deposited film made of the electrically conductive powder can be formed by placing the crimping connection part, in which the metal terminal is caulked and connected with the foregoing exposed core wire of the aluminum electric wire, within a vacuum vessel, providing a vapor source for heating an electrically conductive material to produce a vapor, within the
10 vacuum vessel, and condensing the vapor of the electrically conductive material produced from the vapor source and vapor depositing it in the foregoing crimping connection part.

 In addition, instead thereof, after a vapor deposited film made of an
15 electrically conductive powder is formed on a core wire-exposed part of the aluminum electric wire and a core wire-cut surface by means of vacuum vapor deposition, a copper terminal can be crimp-connected. However, in the case, since there is a concern that the vapor deposited film made of an electrically conductive powder is peeled off by a crimping pressure, it is preferable to
20 subject the vapor deposited film made of an electrically conductive powder to vacuum vapor deposition after crimping.

 The present application is based on Japanese Patent Application No. 2011-113868 filed on May 20, 2011, the contents of which are incorporated
25 herein by reference.

Industrial Applicability

By the above disclosure, a corrosion prevention technology in which the manufacture control of an anticorrosive coating portion is easy, and the reliability of electrical contact between an aluminum electric wire and a metal terminal is not impaired without increasing the size of the crimping connection part can be achieved.

Reference Signs List

10	1	Copper terminal
	2	Terminal part
	3	Coupling part
	4	Wire barrel
	4a, 4b	Barrel piece
15	5	Insulation barrel
	5a, 5b	Barrel piece
	10	Aluminum electric wire
	11	Insulating sheath
	12	Core wire
20	20	Crimping connection part
	21	Evaporation source
	22	Nickel
	24	Vapor deposited film

CLAIMS

1. A structure of a crimping connection part of an aluminum electric wire and a metal terminal,

5 wherein the aluminum electric wire includes a core wire and an insulating sheath covering the core wire;

wherein an exposed core wire in which the core wire is exposed from the insulating sheath at an end portion of the aluminum electric wire is crimped by a core wire crimping part of the metal terminal to form the crimping
10 connection part; and

wherein the exposed core wire and the metal terminal of the crimping connection part are covered by a vapor deposited film comprised of an electrically conductive powder.

15 2. The structure of the crimping connection part according to claim 1, wherein an electrically conductive material of the electrically conductive powder is one of a metal material having an oxidation-reduction potential with a small difference from an oxidation-reduction potential of a metal material of the metal terminal, carbon, and gold.

20 3. The structure of the crimping connection part according to claim 1 or 2, wherein the metal terminal is a terminal formed of copper or a copper alloy, and a surface of the terminal is plated with tin; and

wherein an electrically conductive material of the electrically conductive
25 powder is one of a metal material having an oxidation-reduction potential with a

small difference from an oxidation-reduction potential of tin, carbon, and gold.

4. A method for manufacturing the structure of the crimping connection part according to any one of claims 1 to 3, comprising:

5 placing the crimping connection part, in which the exposed core wire of the aluminum electric wire is crimped by the metal terminal, within a vacuum vessel;

generating a vapor within the vacuum vessel by heating an electrically conductive material; and

10 forming a vapor deposited film on the crimping connection part by condensing the vapor of the electrically conductive material.

FIG. 1

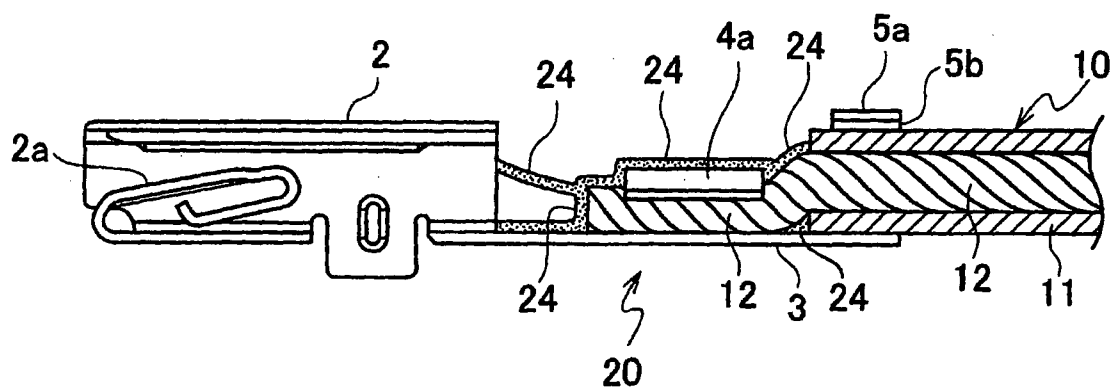


FIG. 2

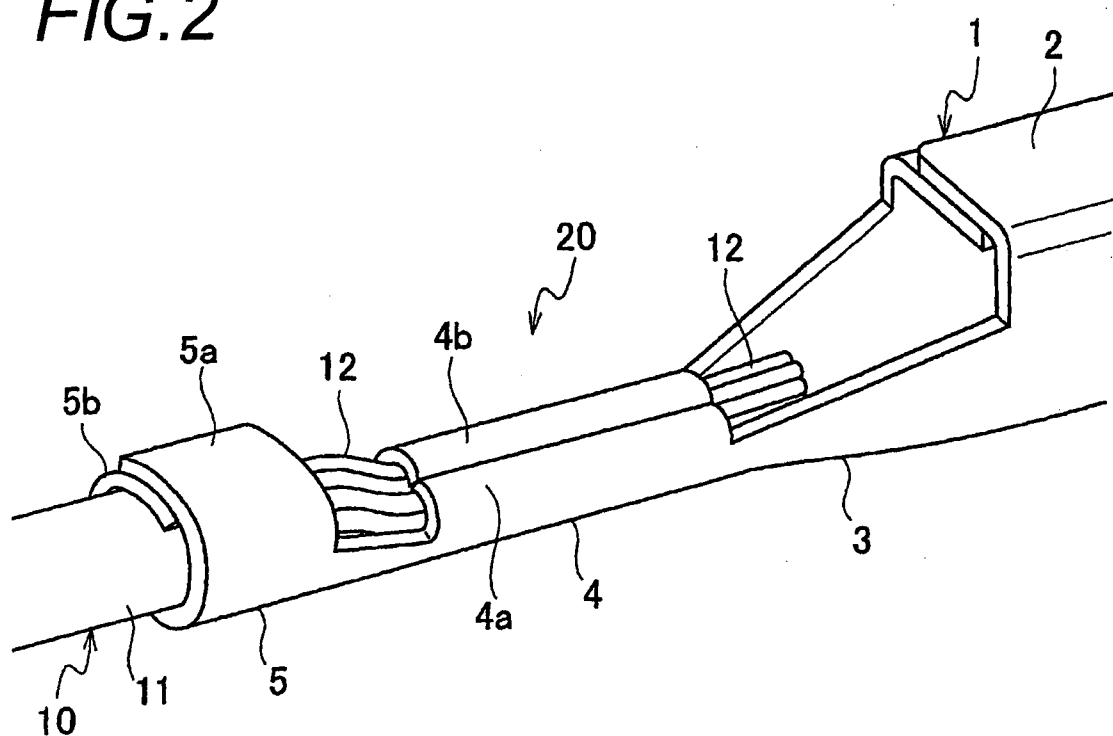
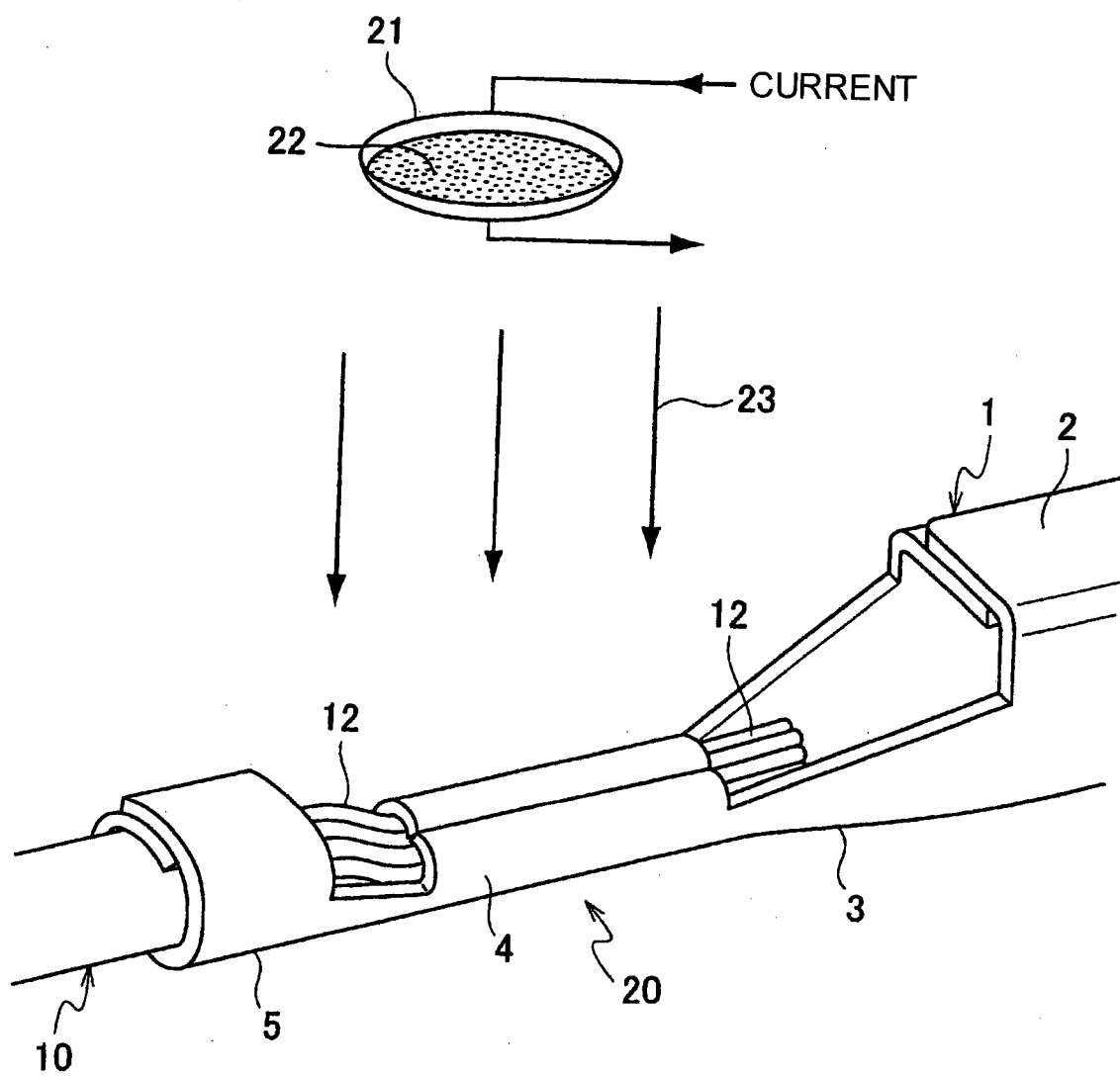


FIG.3



INTERNATIONAL SEARCH REPORT

International application No
PCT/JP2012/063406

A. CLASSIFICATION OF SUBJECT MATTER
INV. H01R4/18
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H01R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EP0-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2010 108798 A (FURUKAWA ELECTRIC CO LTD; FURUKAWA AUTOMOTIVE SYS INC) 13 May 2010 (2010-05-13) cited in the application the whole document	1-4
A	----- WO 2009/096591 A1 (YAZAKI CORP [JP]; SAKAGUCHI TADAHISA; KUWAYAMA YASUMICHI) 6 August 2009 (2009-08-06) page 4 - page 10; claims 1,2; figure 1	1-3
X	----- WO 2009/102074 A1 (YAZAKI CORP [JP]; KUWAYAMA YASUMICHI; SAKAGUCHI TADAHISA) 20 August 2009 (2009-08-20) page 1 - page 10; claim 10 ----- -/--	1-4



Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

17 August 2012

Date of mailing of the international search report

24/08/2012

Name and mailing address of the ISA/

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INTERNATIONAL SEARCH REPORT

International application No
PCT/JP2012/063406

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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